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INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

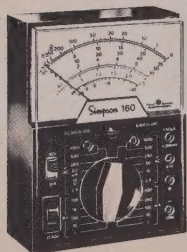
**VOLT-OHM-MILLIAMMETER
Model 230 Series 2**

SIMPSON ELECTRIC COMPANY

5200 W. Kinzie St., Chicago, Illinois 60644
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Simpson



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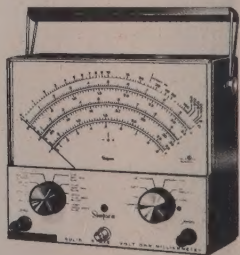
- 20,000 Ω VDC . . . 5,000 Ω VAC
- $\pm 2\%$ DC . . . $\pm 3\%$ AC
- 5 Resistance Ranges . . . Plus a 0-250 DC Millivolt Range

313 Solid-State VOM

VTVM Features . . . VOM Conveniences

- Uses a single 9-volt battery
- 10 Meg Ω DC . . . 11 Meg Ω AC
- Large 7" scale

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OPERATOR'S MANUAL

VOLT-OHM- MILLIAMMETER Model 230 Series 2

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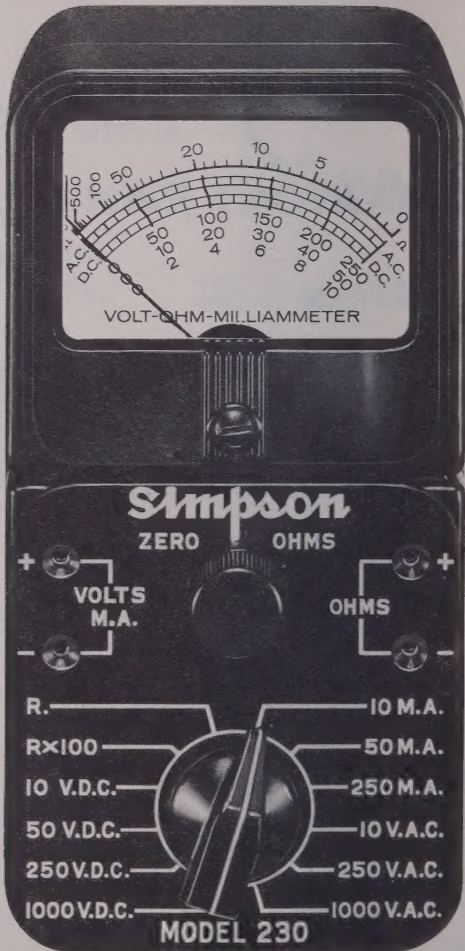


FIGURE 1. SIMPSON VOLT-OHM-MILLIAMMETER
MODEL 230-2

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SECTION I SPECIFICATIONS

D.C. Voltage	Accuracy in % of full scale
Sensitivity: 1000 ohms per volt	
4 Ranges: 0-10-50-250-1000 volts	3

A.C. Voltage	
Sensitivity: 1000 ohms per volt	
3 Ranges: 0-10-250-1000 volts	4

Direct Current	
(150 millivolt drop, maximum)	
3 Ranges: 0-10-50-250 milliamperes	3

Resistance	Accuracy in degrees of arc
2 Ranges: R. for 0-1000 ohms (12 ohm center)	3
R x 100 for 0-100,000 ohms (1200 ohm center)	3

Voltage supply for Ohmmeter Circuit

Battery, P.R. Mallory No. Mn-1500,
or equivalent 1.5 volt cell

Overall Dimensions 3-1/16" x 5-7/8" x 2-5/8"

SECTION II

GENERAL DESCRIPTION

The Simpson Volt-Ohm-Milliammeter Model 230-2, shown in Figure 1, is a handy and compact combination instrument which has been designed for use in servicing radio receivers. It is also useful for many other electrical and electronic applications.

It has convenient ranges for measuring D.C. voltages, direct currents, resistances, and A.C. voltages. All the ranges and circuit arrangements available can be set easily and quickly with the range switch at the bottom of the front panel. The test leads connect into circuit jacks on the front panel, and are used to contact the source of electrical characteristics for measurements.

METER MOVEMENT

The meter movement is one of the famous Simpson INSTRUMENTS THAT STAY ACCURATE. It has a sensitivity of 400 microamperes D.C., with an internal resistance of 365 ohms. The special 2-1/2" dial is calibrated for all the measuring circuits and ranges of the Model 230-2.

General Description

TEST LEADS

The pair of test leads, one red and one black for polarity identification, are approximately four feet long. These test leads are furnished with crocodile clip terminations.

Either clip the leads to the test points in the circuit which is being measured, or hold the clip ends on the test points for momentary contacts.

INSULATED CLIPS

Flexible plastic insulators over the crocodile clips protect the operator from contacting any voltage present on the clips.

RANGE SWITCH

There are two control knobs on the front panel. The large one at the bottom is the range switch. It has twelve positions, each marked for the circuit and the range which it will set up in the instrument.

ZERO OHMS

The small knob above the range switch is the ZERO OHMS control knob. It operates a variable resistor which will compensate for aging of the internal battery when a resistance measuring circuit is used.

General Description

TEST LEAD CONNECTIONS

Two pairs of terminal jacks for the test leads are also located on the front panel. On the left side is the pair of jacks for measuring voltage or current with the Model 230.

The pair of jacks for measuring resistances is located on the right side.

INTERNAL CONSTRUCTION

The upper half of the instrument case contains the meter assembly. Inside the lower half of the instrument case is a printed circuit board containing the range switch, the battery, all resistors, and diodes which make up the circuits for the various ranges.

SECTION III

OPERATING INSTRUCTIONS

CAUTION

When measuring voltage, as a personal protection, form the habit of turning off all power to the circuit under test. Connect the test leads at the desired points in the circuit. Then turn on the power while taking readings. Turn off the power before disconnecting the test leads from the circuit.

Operating Instructions

ADJUST POINTER FOR ZERO

Before any measurements are made with your Volt-Ohm-Milliammeter Model 230, check to see that its pointer indicates zero with the instrument in its operating position. If the pointer is off zero, adjust the screw located in the phenolic case just below the center of the dial.

Use a small screwdriver to turn this screw slowly either clockwise or counterclockwise until the pointer rests over the zero mark on the dial.

D.C. VOLTAGE MEASUREMENTS

1. Set the range switch at the bottom of the front panel for the D.C. voltage range desired. These positions are marked 10 V.D.C., 50 V.D.C., 250 V.D.C., and 1000 V.D.C. **When in doubt as to the voltage present, always use the highest range as a protection to the instrument.** If the voltage reading is within a lower range, the range switch may then be set for a lower range to obtain a more accurate reading.
2. Plug the black test lead into the jack marked —VOLTS M.A. on the left side of the front panel. Plug the red test lead into the jack marked +VOLTS M.A.

Operating Instructions

3. Connect the crocodile clip end of the black test lead to the negative side of the circuit to be measured, and the crocodile clip end of the red test lead to the positive side of the circuit.
4. Turn on the power in the circuit which is to be measured. If the pointer of the meter deflects to the left, the leads are reversed with respect to circuit polarity. Turn off the power, reverse the test lead connections, and then turn on the power again.
5. Read the voltage on the black arc marked D.C.

For the 10 V.D.C., 50 V.D.C., and 250 V.D.C. ranges, read the voltage directly on the black arc.

For the 1000 V.D.C. range, read the 0 to 10 scale on the black arc and multiply the reading by 100.

6. Turn off the power before disconnecting the test leads.

A.C. VOLTAGE MEASUREMENTS

1. Set the range switch at the bottom of the front panel for the A.C. voltage range desired. These are marked 10 V.A.C.,

Operating Instructions

250 V.A.C., and 1000 V.A.C. **When in doubt as to the voltage present, always use the highest voltage range as a protection to the instrument.**

2. Plug the black test lead into the jack marked —VOLTS M.A. on the left side of the front panel. Plug the red test lead into the jack marked +VOLTS M.A.
3. Connect the crocodile clips of the test leads to the two sides of the circuit to be measured. Connect one clip to each side of the circuit. For A.C. voltage measurements, readings will be the same with either polarity of lead connections.
4. Turn on the power in the circuit to be measured.
5. Read the voltage on the red arc marked A.C.

For the 10 V.A.C. and 250 V.A.C. ranges, read the voltages directly on the red arc.

For the 1000 V.A.C. range, read the 0 to 10 scale on the red arc and multiply the reading by 100.

6. Turn off the power before disconnecting the test leads.

Operating Instructions

D.C. RESISTANCE MEASUREMENTS

CAUTION

Before you make any resistance measurements in an electrical circuit, be sure the power is off and all capacitors have been discharged, so no voltage exists in the circuit. Otherwise you may damage the meter circuits.

1. Set the range selector switch at the bottom of the front panel for the range desired for resistance measurement. These switch positions are marked R. and Rx100.
2. Plug the black test lead into the jack marked —OHMS on the right side of the front panel. Plug the red test lead into the +OHMS jack.
3. Short the crocodile clips together. Rotate the ZERO OHMS knob until the pointer indicates 0 at the right hand end of the dial. If the pointer will not move to the 0 mark, the battery is weak and needs to be replaced. See instructions in Section IV, MAINTENANCE.
4. Separate the test leads and connect them across the resistance or the portion of a circuit which is to be measured. The

Operating Instructions

most accurate reading is obtained on the range which indicates nearer the center of the scale.

5. Read the value indicated on the black arc at the top of the dial, marked Ω . Note that this scale increases from right to left.

For the R. range, read the resistance directly on the Ω arc. ($K=1000$).

For the R x 100 range, read the indication on the Ω arc and multiply the reading by 100.

See instructions in Section V for measuring resistances over 100,000 ohms.

DIRECT CURRENT MEASUREMENTS

CAUTION

Never connect the test leads directly across any voltage with the Model 230 set for current measurements. This would damage the instrument. Always connect the meter in series with the load.

1. Set the range switch for the current range desired. These switch positions are marked 10 M.A., 50 M.A., and 250 M.A. **When in doubt as to the current present,**

Operating Instructions

always use the highest current range as a protection to the instrument.

2. Plug the black test lead into the jack marked —VOLTS M.A. on the left side of the front panel. Plug the red test lead into the jack marked +VOLTS M.A.
3. Open the circuit in which current is to be measured. Connect the Model 230 in series with the circuit. Connect the red test lead toward the positive side of the circuit and the black test lead toward the negative side.
4. Turn on the power in the circuit to be measured. If the pointer of the meter is deflected to the left, the leads are reversed with respect to circuit polarity. Turn off the power, reverse the test leads, and turn on the power again.
5. Read the current values in milliamperes on the black arc of the meter marked D.C. Use the 0 to 10 figures for the 10 M.A. range, the 0 to 50 figures for the 50 M.A. range, or the 0 to 250 figures for the 250 M.A. range.
6. Turn off the power before disconnecting the test leads.
7. Restore the circuit continuity.

SECTION IV

MAINTENANCE

CARE

This tester is very rugged and will withstand considerable use without showing any signs of damage. However, the parts are made to fit together with the precision of a fine watch, and they can be damaged by careless handling..

Be careful to prevent your Model 230 from being dropped, and from any other unnecessary shocks. If you treat your instrument with care, it will reward you with many years of trouble-free service and accurate indications of measured values.

HOW TO OPEN INSTRUMENT

The lower half of the instrument can be taken out of the case for trouble-shooting, repair, and battery replacement when it is necessary.

To open the instrument remove the four screws through the back of the case and pull the lower half of the instrument toward the bottom and out of the case. All the compo-

Maintenance

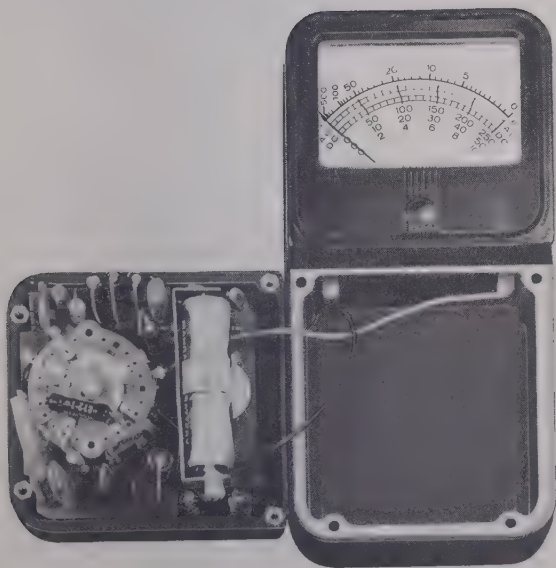


FIGURE 2. MODEL 230-2 WITH CASE OPENED TO SHOW INTERNAL COMPONENTS.

Maintenance

nents will come out with the front panel as shown in Figure 2. There are two wire leads which connect these circuit portions to the indicating meter; when you remove the lower portion of the instrument from the case, be careful to prevent damage to the leads.

REPAIRING THE METER

Since all repair to the meter portion of the Model 230 should be performed only by qualified repairmen with the proper tools, the top half of the instrument is sealed. Do not attempt to remove it from the case.

If any repair is necessary, return the entire Model 230 to the Repair Department at the factory, or to your nearest Authorized Simpson Repair Station.

Whenever you return an instrument to a repair station or to the factory, be sure to write a letter to explain exactly what you think is wrong with it and why. This will save both time and money for you. Also indicate in the letter what you want the repair station or factory to do, so they have the necessary authorization from you to proceed with your repairs.

Maintenance

BATTERY REPLACEMENT

The 1.5 volt dry cell inside the case of the Model 230-2 is used for resistance measurements. During its normal life the battery will gradually increase its internal resistance. This will result in a decrease of terminal voltage under normal load.

When the pointer can no longer be brought to 0 on the Ω (ohms) arc with the ZERO OHMS knob, open the instrument as described above, remove the old battery and slip a new 1.5 volt, size AA manganese cell into the battery holding clamp. Place the battery into the holder so that the plus (+) pole is adjacent to the insulated contact with the brown lead.

RECTIFIER REPLACEMENT

Two germanium diodes are used to rectify the A.C. voltage for measurement. Both these diodes D1 and D2 are located on the printed circuit board as shown in Figure 3.

In case of rectifier failure replace defective diode with another 1N87G. Observe correct polarity and lead locations of the diodes when assembling and soldering them into the

Maintenance

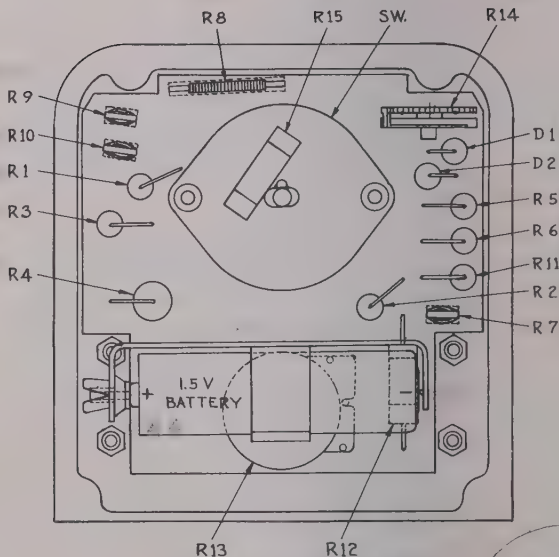


FIGURE 3. LOCATION OF PARTS ON PRINTED CIRCUIT BOARD.

printed circuit board. Both diodes are mounted in standoff position with the anode pole adjacent to the printed circuit board. After replacement of the rectifier diodes test the accuracy of the A.C. ranges.

Maintenance

A.C. RECALIBRATION

After repair of the tester and replacement of the rectifier diodes, A.C. recalibration may be required.

If necessary, recalibrate the circuit by adjusting variable resistor R14 located on the printed circuit board, shown in Figure 3, as follows:

1. Set the range switch at the 10 V.A.C. position.
2. Plug red test lead into the +VOLTS jack.
3. Plug black test lead into the —VOLTS jack.
4. From a standard source apply 10 V.A.C. to the red and black test leads.
5. Adjust R14 so that meter pointer indicates full scale.
6. Then check other ranges.
7. Case the tester by sliding panel assembly carefully into the case. Do not touch and disarrange the rotor knob of the calibrating potentiometer R14. Tighten four casing screws through the back of the case.

Maintenance

REMOVING THE PRINTED CIRCUIT BOARD

When you require access to the underside of the printer circuit board, remove the printed circuit board in the following manner.

1. Remove the knob for the ZERO OHMS control.
2. Remove the hex nut from the control bushing on the top of the front panel.
3. Lift the printed circuit board away from the front panel. The entire board, with the switch wafers in place, will come off in one piece.
4. After removal do not turn the range switch knob on the front panel or move range switch rotors on the printed circuit board until reassembled.

Maintenance

PARTS LIST

Reference Symbol	Description	Simpson Part No.
R1	Resistor, 9.85K ohms, 1%, 1/2 watt	5-110654
R2	Resistor, 40K ohms, 1%, 1/2 watt	1-113309
R3	Resistor, 200K ohms, 1%, 1/2 watt	1-117146
R4	Resistor, 750K ohms, 1%, 1 watt	5-110656
R5	Resistor, 450 ohms, 1%, 1/2 watt	1-110551
R6	Resistor, 1.142K ohms, 1%, 1/2 watt	5-110655
R7	Resistor, 11.8 ohms, 1/2% (wire-wound)	10-675270
R8	Resistor, 12.16 ohms, 1% (wire-wound)	10-675271
R9	Resistor, 2.43 ohms, 1% (wire-wound)	10-675272
R10	Resistor, 0.6 ohm, 1% (wire-wound)	10-675273
R11	Resistor, 9.25K ohms, 1%, 1/2 watt	1-119736
R12	Resistor, 1.276K ohms, 1%, 1/2 watt	1-118199

Maintenance

Parts List

Reference Symbol	Description	Simpson Part No.
R13	Potentiometer 1.5K ohms $\pm 20\%$	5-110650
R14	Potentiometer, 5K ohms $\pm 30\%$	5-110753
R15	Resistor, 243 ohms, 1%, 1/2 watt	1-119540
D1	Diode, germanium, type 1N87G	1-115970
D2	Diode, germanium, type 1N87G	1-115970
Sw	Switch, 2 sections, less frame assembly	5-110651
	Knob, for range switch, (less set screw)	3-262871
	Set screw (for knob 3-262871)	5-110242
	Knob, for Zero Ohms Adjust, set screw included	1-114949
	Test lead set (one red and one black)	0-008375
	Battery, 1.5 volt, size AA, Mallory type #Mn-1500	1-110550
	Meter Assembly, complete with case	15-302230-2

SECTION V

SPECIAL APPLICATIONS

MEASURING HIGH RESISTANCE

With the aid of a circuit such as shown in Figure 5, resistance values up to 1 megohm can be measured. Set the range switch to the $R \times 100$ position. The range set up with this circuit will be $R \times 1000$, so multiply the reading on the Ω (ohms) scale of the dial by 1000 (add three zeros).

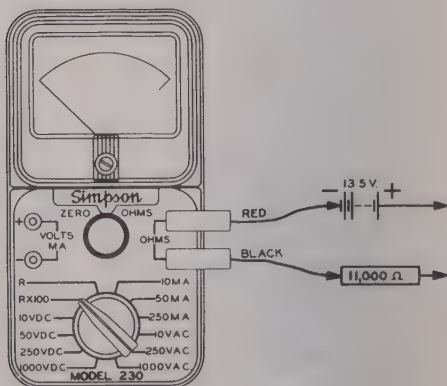


FIGURE 5. INCREASING RESISTANCE RANGES

Special Applications

Use any available combination of batteries to make up 13.5 volts, which is 9 cells in series. One combination would be three 4.5 volt C batteries in series. Another would be two 6 volt batteries and one 1.5 volt cell in series. Still another way to get it is to use two C batteries with five cells each, which have taps at each 1.5 volts; use the entire 7.5 volts from one battery and four cells (6 volts) from the second, all connected in series.

As long as ZERO OHMS can be set for 0 (full scale) indication on the ohms scale, any voltage deviation from the rated 13.5 volts will have negligible affect on the accuracy of the measurement.

Best accuracy will be obtained when the series resistor value is exactly 11,000 ohms, as indicated in Figure 5, but such accuracy is usually not required for resistance readings. Resistance tolerance of $\pm 5\%$ will provide satisfactory indications with the ohmmeter. Resistor does not have to be a single one, but can be any combination which will produce a series equivalent resistance of 11,000 ohms.

MEASURING HIGH VOLTAGE D.C.

Occasionally there may be some voltage greater than 1000 volts D.C. which must be

Special Applications

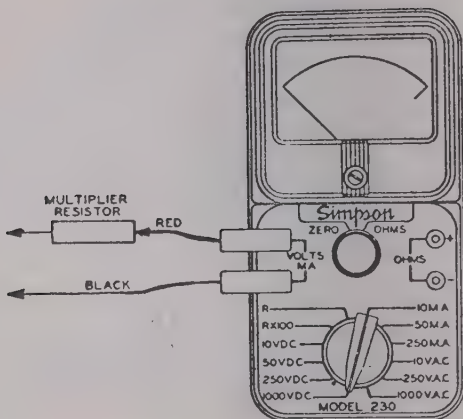


FIGURE 6. INCREASING VOLTAGE RANGES

measured. When this is true, the range of the Model 230 can be increased by adding an external series multiplier resistor as shown in Figure 6. Use the following steps.

1. Set the range switch at 1000 V.D.C. and connect the test leads in the VOLTS M.A. jacks at the left side of the instrument. Connect the red test lead in the +jack and the black test lead in the -jack.

Special Applications

2. Connect the crocodile clip of the red test lead to one terminal of the multiplier resistor. Use a 4 megohm, 10 watt, resistor to set up a 5000 volt D.C. range, or a 9 megohm, 20 watt, resistor to make a 10,000 volt D.C. range.
3. Use the other terminal of the multiplier resistor as the positive probe, and the black test lead as the negative probe. Connect these into the circuit where you wish to measure voltage, **while the power is off.**

CAUTION

Never touch the meter, leads, or any other parts of the measuring circuit while power is on for high voltage measurements. Connect and disconnect the leads while power is off and there is no voltage in the circuits.

4. Observe the reading on the meter as for lower D.C. voltage measurements.
5. **Turn off the power** before disconnecting the probes from the circuit.

SIMPSON WARRANTY REPAIR STATIONS AND PARTS DEPOTS

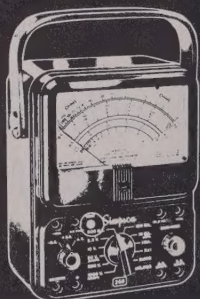
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Washington, Seattle 98119 The Instrument Lab., Inc. 934 Elliott Avenue West	Area Code 206 283-5850
Wisconsin, Milwaukee 53202 The Electro-Mechano Company 241 East Erie Street	Area Code 414 272-4050

GOOF- PROOF VOM



Here's the most foolproof volt-ohm-milliammeter ever made. Protection approaches 100%. It's the VOM you will want to have on hand where inexperienced people are running tests . . . or will reach for yourself on those days when you're all thumbs. The 260-5P will save you all kinds of headaches from burned out meters and resistors, bent pointers, and inaccuracies caused by overheating.

SIMPSON 260-5P

Combined Protection You Won't Find in Any Other VOM

1. Reset button pops out to indicate overload.
2. You cannot reset circuits while overload is present.
3. Protective circuit does *not* require massive overloads which can cause hidden damage to the instrument.
4. All ranges are protected except those not feasible in a portable instrument—1000 and 5000 volts DC and AC; 10 amp DC.

Ranges—The 260-5P has the same ranges and takes the same accessories as Simpson's famous 260-4 VOM.

Simpson
DIVISION

Representatives in Principal Cities
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WORLD'S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT

Warranty

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles of equipment manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any instrument or other article of equipment which shall within 90 days after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any instrument or other article of equipment which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

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